in the chapter on fire and aquatic and watershed resources. This example could have been followed in describing collateral damage from commercial logging and grazing treatments done in the name of fire managment.

Conclusions

The topic of fire in California ecosystems is complex and multidisciplinary, and very difficult to encompass in one book. *Fire in California's Ecosystems* summarizes well much of the relevant literature. However, there are important topics that are omitted or not adequately addressed with up-to-date perspectives. Other literature can fill these gaps. Bond and van Wilgen's 1996 short classic, *Fire and Plants*, better addresses fire as an ecological and evolutionary force and recognize it as a natural disturbance process. These are important perspectives for understanding fire, particularly as it affects plant biology and biodiversity. Perspectives that do not shy away from critically analyzing existing land management and planning, and that more broadly consider solutions to today's wildfire problems are also important to consider. In addition to the aforementioned books by Halsey (2005) and Kennedy (2006), a good accompaniment to *Fire in California's Ecosystems* is the recently published book *Wildfire: a Century of Failed Forest Policy*, edited by Wuerthner (2006). As these books point out, incentives created by huge fire budgets and commercial activities discourage pursuit of specific actions needed for protecting human communities from fire and restoring fire regimes in plant communities. These are particularly important needs in California.

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CALIFORNIA'S FIRE ECOLOGY: A NEW SYNTHESIS

In the foreword to *Fire in California's Ecosystems* Jim Agee predicts: "The volume you hold now will become the secular bible of fire ecology for Californians." Dr. Agee's statement implies that the reader need look no further to satisfy his/her questions regarding ecology and management of fire in the nation's third-largest state. *Fire in California's Ecosystems* is a comprehensive synthesis of the current state of knowledge for fire ecology and management in California's diverse ecosystems.

The book is organized in three parts, including a first section on basic fire ecology, followed by a collection of chapters describing fire ecology and management for each of nine bioregions, culminating in a collection of eight chapters geared towards over-arching fire management issues. *Fire in California's Ecosystems* is very well put together for a collection of contributed chapters. The editing is polished and the authors have followed a common organizational template. Sidebars are generally very useful and cover topical features such as fire climate, landscape dynamics of chaparral communities, plant adaptations to fire, and exotic annual grasses, to name only a few. Illustrations and GIS maps are clear, consistent among chapters, and professionally formatted. Copies and scans of many of these illustrations are sure to appear

in numerous lectures on fire ecology and forest management.

The first seven chapters would be valuable reading for any fire ecology course, anywhere in the world. Each of these chapters is clear and comprehensive. Taken together they provide a solid overview of fire as an ecological disturbance. Chapters cover the basic concepts of fire ecology with regard to weather and climate, fire physics, fire regimes and plant community dynamics, fire effects on the environment, fire effects on plants, and fire effects on animals. Unfortunately, the coverage of ecosystem effects of fire is relatively limited. The "physical environment" effects of fire (soil, water, air) are covered in just one chapter (Chapter 5). This chapter is well-presented, but this is a huge area of study and the book might have been better served as a core fire ecology text if the air, soil and biogeochemistry, and water effects had been broken out into separate chapters. Also, this chapter omits discussion of fire regime change (e.g., fire exclusion effects). Chapter 6 on *Fire and Plant Interactions*, contributed by Joann Fites-Kaufman and coauthors, includes an informative discussion of plant adaptations and fire effects across several levels of ecological organization. Jon Keeley has contributed a thoughtful sidebar on the evolution of fire adaptations.

The nine bioregional chapters (Part II of the book) are organized consistently according to subdivisions of ecological zones, and vegetation alliances within ecological zones. Each of these chapters includes a general description of the physical environment, an overview of fire history, a description of major ecological zones including fire ecology and interactions between the fire regime and plant communities, and contemporary management issues. Included in each chapter are tables summarizing life history adaptations to fire for key plant species within each bioregion, as well as summary tables describing fire regime parameters (fire seasonality, return interval, extent, severity, etc.) for each vegetation type. Such organizational consistency is impressive and doubtless reflects strong-willed editorship as well as substantial commitment on the part of the authors. A high level of organization is needed to create a coherent picture of such diverse fire environments and ecological systems as are contained within the political boundaries of California, which includes the highest and lowest elevations of the lower 48 states.

Most of the regional chapters are written by scientists with considerable local experience in their assigned ecoregion, and many excellent narratives are included in the book. The Klamath Mountains chapter (by Carl Skinner) provides a well-honed discussion of how fire behavior and fire regime have interacted with the physical landscape template, with respect to the distinctly convoluted topography and famously complex geology of those particular mountains. The Northeastern Plateaus chapter (by Gregg Riegel), describing California's portion of the Great Basin, includes a nuanced description of fire ecology in the sagebrush steppe zone. There are useful discussions of interactions among fire regime, plant community succession, and directional vegetation shifts such as have been prevalent in the western United States over the past century. Many of the regional chapters, and especially the Sierra Nevada chapter (by Jan van Wagtendonk), contribute discussions of historical human influences including those prior to Euro-American settlement, and place current fire and forest management issues within this long-term context. A recurring theme of the regional chapters is the importance of fire exclusion for altering contemporary fire regime and ecological processes. As stated in the Sierra Nevada bioregional chapter (p. 290), "The question becomes how to restore natural fire regimes without adversely affecting at-risk species and their habitats... These species evolved with fire and the answer must include fire." However, bioregions that are characterized by chaparral vegetation at lower elevations (South Coast, portions of the Central Coast) now experience more frequent fires than historically, as a result of human ignitions and urbanization.

Several of the bioregional chapters (North Coast, Southern Cascades, Central Valley) paint a picture of Native American burning that, while quite plausible, is supported by a paucity of primary literature sources. The strength of evidence supporting native burning could be presented in a less anecdotal fashion, and the authors could have made clearer that while aboriginal fire may have been critical for shaping vegetation structure in certain vegetation types, it was likely of low importance for other types, such as those in less productive, high-elevation areas.

The final section of the book (Chapters 17–24) addresses fire management issues that range from the over-arching to the very practical. The important questions are not neglected. How can we describe a historic range of variability, or meaningful reference conditions for restoration, in the context of Native American fire use? How can we incorporate fire use in our management planning and still protect people and their resources given the great increases in population over the past decades? These chapters emphasize fire effects and discuss the negative effects of fire use that can occur with less than perfect planning, with respect to aquatic systems, air quality, exotic plant invasions, and habitat for at-risk species.

Chapter 17, contributed by Kat Anderson, presents an exhaustive yet balanced description of Native American fire use. The chapter describes the continuum of influences across this

large and heterogeneous state, including areas of low influence due to low population (serpentine and subalpine environments) as well as areas where Native American fire management was likely high because of high population densities and cultural fire use (northwest coastal prairies region).

In Chapter 18, Scott Stephens and Neil Sugihara provide a thorough background into the historical events and cultural influences leading to the triumph of fire suppression policies over a "light burning" paradigm for forestry in the western U.S. The discussion eventually winds its way to contemporary fire management including new manifestations of the fire use paradigm, leading to today's changing perspectives and policy shifts. Husari et al. (Chapter 19) continue with this theme in their chapter on fire and fuel management, describing the shift in management focus and policy from fire control to fuel management. As for most of the other chapters in this book, there is a laudable effort to place where we are today in the context of past management practices and historical influences.

Chapters 20–23 describe fire management issues regarding aquatic resources, air quality, invasive plant species and species of conservation concern. The first of these chapters (watershed resources, contributed by Andrea Thode and others) is brief but well-focused, and performs the amazing feat of not repeating material from earlier chapters. There are useful summary tables contrasting various watershed rehabilitation methods. Fire is treated as an integral watershed process and there is a balanced discussion of controversial ideas pertaining to active management of forested riparian zones. There is useful emphasis on linking watershed restoration and fire management activities. The air quality chapter (by Suraj Ahuja) provides an informative summary of fire effects on air quality and how fire and fuels management are constrained by air quality regulations. The invasive plant species chapter (by Robert Klinger) elucidates the complex, two-way interactions between fire regime and exotic plants. Missing from this chapter is mention of the interaction between fire and invasive forest pathogens such as Sudden Oak Death.

It is unfortunate that the management section of the book lacks a chapter on wildland fire use in undeveloped areas. Over 14 million acres in California are managed as wilderness and how to manage wildland fire in these areas has become an issue of prime importance. The management section chapters instead focus almost exclusively on issues of the wildland-urban interface and active forest and fire management in traditionally managed forests.

Neil Sugihara takes the lead in summarizing all three sections of the book (Chapter 24). This final chapter is essentially a call for society to act now to restore fire as an ecosystem process, even when knowledge is incomplete and ecosystem alterations and discontinuities prevent a return to historical conditions. We need to manage fuels and fire regimes so as to counter the ecosystem changes and negative biodiversity effects resulting from a century of fire exclusion. However, certain bioregions and vegetation zones (coastal chaparral, subalpine forests) have not experienced fire exclusion and need to be managed differently, as pointed out by Jon Keeley in his South Coast chapter. Coastal chaparral now burns more frequently and later in the year than prior to settlement, but the actual area burned is within a historic range of variability because suppression efforts keep most fires small. Fire management and landscape restoration must be adapted to the particular bioregional setting, and this book provides the regionally specific information required to support such efforts.

The book's emphasis on providing a compendium of the current state of knowledge regarding California fire ecology can be seen as a limitation as well as a strength, in that it summarizes what we know rather than suggests directions for future research. Some of the chapters could have been reined in a little more with respect to repetitive, extraneous detail. The book has been closely edited for consistency in organization, but not necessarily for content and brevity. *Fire in California's Ecosystems* is not intended to be read cover to cover, but rather will serve as a reference work. The persistent reader will emerge with new information and perspectives gained from diverse scientists and forest managers who have spent considerable portions of their careers working with the topics and geographic areas about which they have written.

This comprehensive, multifaceted work will be informative for fire scientists and managers at all levels. It interweaves biological, physical, cultural and operational aspects of fire science through a collection of contributed chapters. The usefulness of the work clearly transcends the state of California. *Fire in California's Ecosystems* is one of the more valuable fire ecology books to come out in a long time, and it has something to offer nearly everyone: research scientists and university instructors, fire and forest managers, students of various ecological, environmental and natural resource disciplines, and the interested citizen. It may not make for good "light reading" at the beach, but is a resource worth having on your bookshelf.

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